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Analysis of LTE Network Quality of Service on Streaming Application

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***Abstract*—QoS (Quality of Service) measurement of LTE (Long Term Evolution) networks is carried out using the Telkomsel provider. Measurements were made in Perawang, Riau at night. QoS measurements are carried out at Perawang to evaluate and monitor network quality in accessing Vidio streaming services provided by the Telkomsel network in the Perawang, Riau. Measurements were aimed at 5 streaming applications, namely YouTube, RCTI+, Online Radio, Twitch, and Vidio. The reason 5 applications are used for QoS measurement is that these applications are popular applications used in the category of Vidio streaming applications. Measurements were carried out for 160 seconds. The measurement results will be analyzed for quality based on the TIPHON standard. The results were obtained by calculating the data that has been obtained by Wireshark. The data will be calculated using the existing equations. Twitch is the only application that has a value of four in the QoS parameter index category and has a QoS value with an excellent index category. 4 other applications have a QoS value with a good index category. This is due to the low value of the throughput index category. Online Radio and Vidio applications have an index category value of 0. YouTube and RCTI+ applications have a throughput index category value of 1 and 2 respectively. For jitter, packet loss, and delay values, 5 streaming applications have an excellent index category with a value of 4. The measurement results that have been obtained would be displayed in the form of tables and graphs.**

Keywords—LTE, QoS, Wireshark, Streaming, Telkomsel

I. INTRODUCTION

The development of telecommunications networks is increasing. One of the developments that can be felt is the wireless network or often referred to as wireless. LTE (Long Term Evolution) is a wireless network that has been used in Indonesia [1][2]. LTE is a telecommunications network that is part of the fourth generation (4G). LTE was developed by the 3rd Generation Partnership Project (3GPP) [3]. The development of LTE is expected to improve network quality in accessing services to be more optimal in line with the emergence of new mobile applications that are developing so rapidly [4]. The development of digital technology that is happening at this time has a positive impact on life. The existence of the internet makes it easy to obtain information anytime and anywhere. One of the applications of the internet in technological developments is the existence of data streaming technology on various media, both radio and television media [5]. Streaming media is the process of sending broadcast media in real-time. The existence of streaming media allows us to listen to the radio or watch television broadcasts directly, without having to sit near the radio or television [5]. The quality of the LTE network used to access several streaming media applications will be measured and analyzed using QoS (Quality of Service). This is an effort that aims to find out whether the performance of the provider in accessing streaming services is included in the good or bad category [6]. QoS analysis is carried out by measuring QoS parameters and later the measured values will be averaged so that it can be seen whether the QoS is in the good or bad category. In this case, the QoS parameters measured on the LTE network include throughput, jitter, delay, and packet loss [7]. To find out whether the parameter value is good or bad, the standard set by ITU and the TIPHON standard set by ETSI are used [8][9][10].

This paper was written with the aim of knowing the quality of the LTE network in accessing 5 streaming applications that will be measured. The measurement results will be compared with the TIPHON standard made by ETSI

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to find out whether the measured QoS results are included in the good or bad category. Measurements were made in Perawang, Riau at night. QoS measurements are carried out at Perawang to evaluate and monitor network quality in accessing video streaming services provided by the Telkomsel network in the Perawang, Riau.

II. METHODOLOGY

QoS measurement is done by the following steps; a) Read literature studies to look for problems that can be researched. b) Prepare a laptop containing the Wireshark application as a QoS parameter meter, the YouTube application, RCTI+, online radio, Twitch, and vidio as the streaming application to be measured, and the Telkomsel provider as the LTE service used. c) Measure the QoS parameter for 5 streaming applications using the Wireshark application. d) Record the results of the QoS parameter for each streaming application that has been measured. e) Input QoS parameter results to be displayed in tables and graphs. f) Grouping QoS parameter results with quality ratings according to TIPHON standards and providing conclusions. Quality of Service measurement is carried out with a video duration of approximately 160 seconds. The reason for using a time limit of 160 seconds is that it is considered sufficient time to get a general idea of QoS. This can help in identifying problems that occur in a relatively short time. QoS measurements were carried out in Perawang, Riau at night. QoS parameter results are obtained by using the following equations.[11] [12]. Quality of Service measured on the LTE network by throughput is determined using the equation 1,

$$Throughput = \frac{Amount\ of\ Data\ Sent}{Data\ Transmission\ Time} \quad (1)$$

where X and Y values are known, packet loss is calculated as equation 2,

$$Packet\ Loss = \frac{(X-Y)}{X} * 100\% \quad (2)$$

X: data packet sent; Y: data packet received

After funded all packet data, average delay is determined using the following equation 3,

$$Average\ Delay = \frac{Total\ Delay}{Total\ Data\ Packets\ Received} \quad (3)$$

and average jitter determined using the following equation 4,

$$Average\ Jitter = \frac{Total\ Jitter}{Total\ Data\ Packets\ Received} \quad (4)$$

After the results are obtained the results will be compared with the TIPHON standard to be grouped according to the existing ranking. The reason for using the TIPHON standard is that the TIPHON standard provides clear definitions and measurable parameters for QoS. The availability of internet network is not enough to complete those tasks. The other part that takes mainly important role to arrange all these chores is the stability of its internet processes [13]. This standard was developed by ETSI, which gives confidence in the resulting standard. By referring to these standards, service providers and network operators can evaluate their network performance, identify problems, and take necessary corrective actions to ensure good quality of service. The standard types in TIPHON are shown in the following table: [14]-[16]. Table I represent throughput quality type by using index 0 until 4 with various value, starting from 0 up to 2.1 Mbps

TABLE I. THROUGHPUT QUALITY TYPE

Throughput Quality	Type	
	Value	*Index*
Excellent	> 2.1 Mbps	4
Good	1200 kbps – 2.1 Mbps	3
Normal	700 – 1200 kbps	2
Poor	338 – 700 kbps	1
Bad	0 – 338 kbps	0

Table II represent packet loss quality type by using index 1 until 4 with various value, starting from 0% up to 25%.

TABLE II. PACKET LOSS QUALITY TYPE

Packet Loss Quality	Type	
	Value	*Index*
Excellent	0 – 2 %	4
Good	3 – 14 %	3
Normal	15 – 24 %	2
Bad	> 25 %	1

Table III represent delay quality type by using index 1 until 4 with various value, starting from 150ms up to 450ms.

TABLE III. DELAY QUALITY TYPE

Delay Quality	Type	
	Value	*Index*
Excellent	< 150 ms	4
Good	150 – 300 ms	3
Normal	300 – 450 ms	2
Bad	> 450 ms	1

Table IV represent jitter quality type by using index 1 until 4 with various value, starting from 0ms up to 225ms. After grouping based on the results of the QoS parameters that have been measured, the index category points obtained will be used to obtain the average index value. The average value of the index would be analyzed according to the standard assessment from TIPHON in Table V. Table V represent QoS percentage and value standard by TIPHON by standard percentage 25% until 100% with various value, starting from 1 up to 4.

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TABLE IV. JITTER QUALITY TYPE

Jitter Quality	Type	
	Value	*Index*
Excellent	0 ms	4
Good	0 – 75 ms	3
Normal	75 – 125 ms	2
Bad	125 – 225 ms	1

TABLE V. QOS PERCENTAGE AND VALUE STANDARD BY TIPHON

Value	Standard	
	Percentage (%)	*Index*
3.8 – 4	95 – 100	Excellent
3 – 3.79	75 – 94.75	Good
2 – 2.99	50 – 74.75	Bad
1 – 1.99	25 – 49.75	Very Bad

III. RESULT AND DISCUSSION

QoS measurement results from 5 streaming applications will be displayed in tables and graphs. The measurement results will be analyzed and the quality will be determined based on the TIPHON standard made by ETSI. After measuring using Wireshark, the data obtained will be calculated using the equation to find out the value of each QoS parameter. The following is an example of calculating QoS parameters in a video application.

$$Throughput = \frac{13{,}385{,}912\ kb}{154{,}443} = 86\ kbps$$

$$Packet\ Loss = \frac{(3{,}227 - 3{,}212)}{3{,}227} * 100\%$$
$$= \frac{15}{3{,}227} * 100\% = 0.046 * 100\% = 0.5\%$$

$$Average\ Delay = \frac{154.4426}{3{,}227} = 0.47874\ s$$
$$= 47.87434\ ms$$

$$Average\ Jitter = \frac{1.320444}{3{,}227} = 0.000409\ s$$
$$= 0.40944\ ms$$

From the Table VI throughput data that has been obtained, it can be seen the Twitch application has the best throughput index category with index category 4. Twitch has a throughput value greater than 2.1 Mbps, which is 3.88 Mbps Radio Online and video applications have the worst throughput index category with index category 0, because the throughput value is less than 338 kbps, with each throughput value of 114 kbps and 86 kbps. For YouTube it gets a category 1 index with a throughput value of 458 kbps, and RCTI+ gets a category 2 index with a throughput value of 740 kbps.

TABLE VI. THROUGHPUT RESULTS OF EACH STREAMING APPLICATION

Application	Result	
	Throughput (kbps)	*Index Category*
Youtube	458	1
Radio Online	114	0
RCTI+	740	2
Twitch	3880	4
Vidio	86	0

TABLE VII. PACKET LOSS RESULTS OF EACH STREAMING APPLICATION

Application	Result	
	Packet Loss (%)	*Index Category*
Youtube	0.1	4
Radio Online	0	4
RCTI+	0	4
Twitch	0	4
Vidio	0.5	4

For packet loss results of 5 streaming applications that are measured in Table VII, all streaming applications have the best index category with a value of 4. This happens because the amount of packet loss from 5 applications that is measured is less than 2%

TABLE VIII. AVERAGE DELAY RESULTS OF EACH STREAMING APPLICATION

Application	Result	
	Average Delay (ms)	*Index Category*
Youtube	13.233712	4
Radio Online	40.694658	4
RCTI+	14.848698	4
Twitch	2.97325	4
Vidio	47.87434	4

The results of the average delay in the 5 applications measured have an index category of 4 in Table VIII. These 5 applications have a delay value of less than 150ms. Twitch is the application with the lowest average value of 2.97325 ms. From the data that has been collected, the average value of jitter for 5 applications is included in the best index category worth 4 points are shown in Table IX. These 5 applications have a jitter value of less than 1ms. All QoS parameter measurement results from 5 streaming applications have been collected and analyzed. The last step to be taken in determining the quality of QoS service is to get the average index point. The average index point value will be analyzed to determine whether each streaming application has a good or bad index category based on Table V.

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TABLE IX. AVERAGE JITTER RESULTS OF EACH STREAMING APPLICATION

Final Result	Application				
	YouTube	*Radio Online*	*RCTI+*	*Twitch*	*Vidio*
Throughput Index	1	0	2	4	0
Packet Loss Index	4	4	4	4	4
Delay Index	4	4	4	4	4
Jitter Index	4	4	4	4	4
Total Index	13	12	14	16	12

TABLE X. THE FINAL RESULT OF QOS MEASUREMENT

Application	Result	
	Average Jitter (ms)	*Index Category*
Youtube	0.00040469	4
Radio Online	0.00000248	4
RCTI+	0.0000609774	4
Twitch	0.0003383	4
Vidio	0.40944	4

From the table X, information can be taken that the twitch application has the best QoS value of the four other streaming applications, namely 4. That is, Twitch is included in the excellent category. The lowest QoS value is owned by the Radio Online and Video applications with a value of 3. The low score obtained by the Radio Online and Video applications does not make this application categorized in the worst category. The Radio Online and Video applications are categorized in a good rating, the same as those obtained by the Youtube and RCTI+ applications. Based on the QoS quality value of each application that has been obtained, it can be seen the quality of QoS on Youtube, Radio Online, RCTI+, and Video applications are included in the good category, and for the Twitch application, the quality of QoS is included in the excellent category. With these results, Telkomsel providers are expected to be able to further improve network quality for YouTube, RCTI+, video, and Radio Online application services.

IV. CONCLUSION

QoS analysis on LTE networks is carried out using Telkomsel providers. Measurements were made in Perawang, Riau at night. The measurement is aimed at 5 streaming applications, namely; YouTube, Radio Online, RCTI+, Twitch, and Vidio. QoS measurements were carried out using the Wireshark application with a measurement time of 160 seconds. After measuring the QoS parameters, the measurement results will be analyzed with the TIPHON standard. The measurement results will be inputted into a table so that it can be displayed in graphical form. For the throughput values obtained, Radio Online and Vidio have an index value of 0. YouTube has an index value of 1, RCTI+ has an index value of 2, and Twitch has an index value of 4. For packet loss, delay, and jitter, 5 streaming applications have an index value of 4. The QoS parameter values obtained will be used to look for QoS quality. The Twitch application has a QoS value of 4 with an excellent index category. The Youtube, Radio Online, RCTI+, and Vidio applications are included in the good index category with different QoS values. The Radio Online and Vidio applications have a QoS value of 3, the Youtube application has a QoS value of 3.25, and the RCTI+ application has a QoS value of 3.5.

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